Office of Science
Executive Summary

INTRODUCTION

The Office of Science (SC) requests $3,310,935,000 for the Fiscal Year 2004 (FY 2004) Science appropriation, an increase of $47,059,000 over FY 2003, for investments in basic research that are critical to the success of the Department of Energy (DOE) missions in: national security and energy security; advancement of the frontiers of knowledge in the physical sciences and areas of biological, environmental and computational sciences; and, provision of world-class research facilities for the Nation's science enterprise.

The Office of Science is the single largest supporter of basic research in the physical sciences, providing approximately 40 percent of all federal funds in this area over the past decade. It is also the steward, and by far the principal funding agency, of the nation's research programs in high-energy physics, nuclear physics and fusion energy sciences, as well as being the federal government's largest single funder of materials and chemical sciences. SC also supports unique or critical pieces of U.S. research in scientific computation, climate change, geophysics, genomics, and the life sciences. This research is conducted at both the DOE national laboratories and at approximately 250 universities nationwide. SC manages the construction and operation of some of the nation's most advanced R&D facilities - a vital part of the Nation's scientific infrastructure used by over 18,000 researchers annually.

The Nation's investment in the Office of Science has paid off handsomely. New materials have resulted in high energy batteries, the world's highest efficiency solar cells, and more efficient engines, while new catalysts have resulted in more energy-efficient industrial processes. The Administration has decided to enter negotiations to construct an international burning plasma experiment, based in large part on SC research and design efforts. Our high energy and nuclear physics programs are world leaders. SC initiated the Human Genome Project, and gave birth to the field of nuclear medicine and funded research that led to development of the positron emission tomography (PET) scan. SC is also essential to the education of the next generation of researchers: its grants to universities now support approximately 1/3 of all doctorates awarded in physical science.

Our economy, our energy security and our national security depend upon our scientific primacy. Beginning with the impact on technology development of scientific discoveries in chemistry and electromagnetism at the end of the 19th century, scientific discovery has become the source of new technologies that are critically important to national security and economic progress. Today, advances in computing, communications and scientific instruments – many of them developed by SC – have transformed the conduct of science and created new scientific opportunities that promise revolutionary technologies to come.

> "*.....steady advances in the tools available for technical work have recently crossed a threshold of capability that open entirely new frontiers for scientific discovery, and provide unprecedented power for the analysis and solution of real-life problems*."
>
> Dr. John Marburger, Director, Office of Science and Technology Policy

The Office of Sciences' traditional strengths in scientific computing, construction and operation of scientific facilities, and management of large interdisciplinary programs of research will enable it to maintain continued world scientific leadership in the 21st century.

In FY 2004 the Office of Science will:

- Enter negotiations with representatives of the European Union, Japan and Russia on construction and operation of a burning plasma experiment - the International Thermonuclear Experimental Reactor (ITER).

- Continue to build on its leadership in high performance computing and networking to bring the full potential of scientific computation to bear on the Department's scientific problems. It will initiate a Next Generation Computer Architecture program to identify and address performance bottlenecks in existing and planned systems.

> *"…development of capabilities in high-end scientific computation will enable U.S. industries in general and General Motors in particular to significantly reduce the time-to-market of their products and services. A computing architecture and capability in the order of 100 Teraflops for example would have quite an economic impact, on the order of billions of dollars, in the commercial sector and in its product design, development and marketing."*
>
> Tony Scott, Chief Technology Officer
> General Motors Information Systems and Services

- Continue construction of the Spallation Neutron Source, proceed with construction of three Nanoscale Science Research Centers (NSRCs) and initiate work on two others. These NSRCs located at national laboratories in New York, Tennessee, Illinois, New Mexico and California will provide scientists with an unmatched set of tools to design and build complex nanoscale materials.

- Exploit its unique capabilities at the intersection of the physical sciences, the life sciences and scientific computation to continue and expand its effort to understand how the instructions embedded in genomes control the development of organisms, with the goal of harnessing the capabilities of microbes and microbial communities to help us to produce energy, clean up waste, and sequester carbon from the atmosphere.

- Initiate a Laboratory Science Teacher Professional Development program for K-14 teachers in science and mathematics. Teachers will be competitively selected for a 4-8 week mentoring program by both scientists and master teachers at a national laboratory, followed by both additional 1 week mentoring visits and long term continuing support.

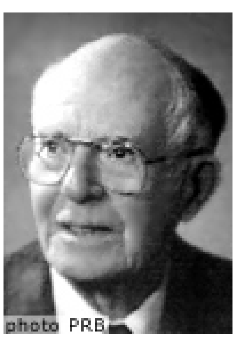
- Exploit the capabilities of the world's finest set of research facilities in particle physics to attempt to find the answers to questions about matter and energy at the most fundamental level. What gives elementary particles their great variety of masses? Are there extra dimensions of space beyond the three we know? Why is there so little antimatter in the universe when we expect equal amounts of each were created in the Big Bang? What is the Dark Energy that causes the recently observed acceleration in the expansion of the universe and comprises fully two thirds of the mass and energy budget of the universe? What were the properties of the early universe before quarks and gluons condensed into protons and neutrons?

HISTORY OF SUCCESS

The Office of Science can trace its roots to the original legislation creating the Atomic Energy Commission in 1947, which had a charter to use fundamental research in nuclear physics and other physical sciences towards "…improving the public welfare, increasing the standard of living, strengthening free competition in private enterprise, and promoting world peace." More than five decades later, the Office of Science can point to an extraordinary and diverse array of scientific discoveries that have led to dozens of Nobel Prizes, a draft map of the Human Genome, the creation of "Bucky Balls", discovery of the quark structure of matter and the "Accelerating Universe," major breakthroughs in medical diagnoses and nuclear medicine, and providing tools that allow researchers to "see" at the atomic and subatomic scales, to simulate complex interactions and to collaborate across great distances.

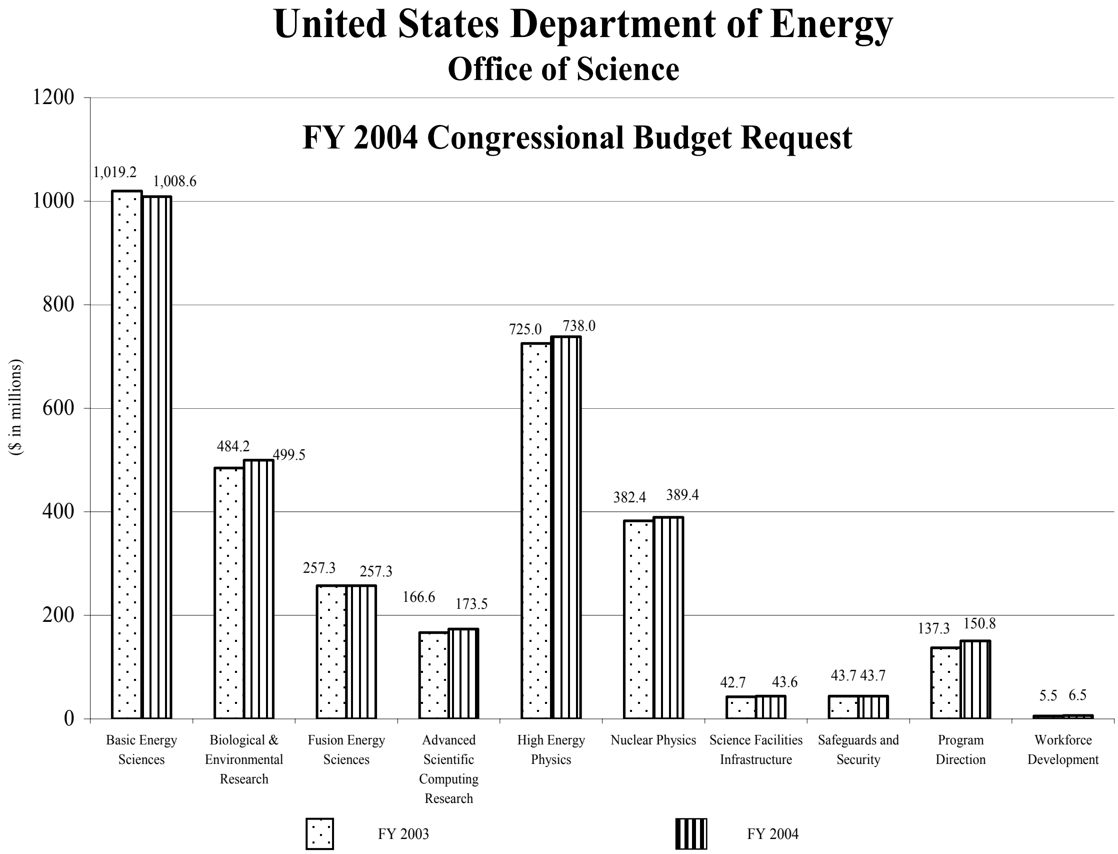
That history of discovery (which is documented on the Office of Science website, www.er.doe.gov/feature_articles_2001/June/Decades/index.html) continues to this day, with major accomplishments in the past year that are the result of the long-term, high-risk, multidisciplinary research sponsored by SC and the strong management practices of the dedicated and highly skilled SC workforce.

Two achievements in 2002 stand out as representative of the scope and magnitude of the research sponsored by SC. First is a technological miracle– restoring sight to the blind – being developed through an extraordinary marriage of biology and the physical sciences. The combination of diverse scientific disciplines such as these is a hallmark of SC research and a particular strength of the DOE national laboratories. But realizing this remarkable technology also relies on the unique capabilities of Industry (Second Sight, located in Santa Clarita, Calif.) and Academia (the Doheney Eye Institute at the University of Southern California and North Carolina State University) in partnership with the national laboratories. In this project, specially designed MEMs (microelectro-mechanical systems) electrodes are positioned on the retinas of patients who have been blinded by disease, enabling them to convert light to electrical pulses that are received by the brain. Today's prototype enables a formerly blind patient to distinguish light from dark. Tomorrow's technology has the potential to restore almost full sight to the 200,000 people in the U.S. who are blinded every year by macular degeneration. This miracle of science is possible due to the long-term commitment of dedicated teams of scientists supported by SC.



The second was the award of the 2002 Nobel Prize for Physics shared by Raymond Davis, Jr., whose sublime experiments led to the capture of solar neutrinos, proving that fusion provides the Sun's energy and leading to the creation of an entirely new field of research: neutrino astronomy. Davis did his groundbreaking work while a researcher at SC's Brookhaven National Laboratory, which is home to multiple Nobel Prize recipients. This is the most recent of the Nobel Prizes that have been awarded to DOE-supported scientists.

In its announcement of the Nobel Prize citation, the Royal Swedish Academy of Sciences said of Davis's accomplishment: "This year's Nobel Laureates in Physics have used these very smallest components of the universe (neutrinos) to increase our understanding of the very largest: the Sun, stars, galaxies, and supernovae. The new knowledge has changed the way we look upon the universe."



FY 2004 PROGRAM SPECIFIC INITIATIVES

The **Advanced Scientific Computing Research** (ASCR) program underpins DOE's ability to accomplish its mission through scientific computation. The ASCR program supports research in applied mathematics, computer science and high-performance networks and provides high-performance computational and networking resources to enable the advancement of the leading edge science that the DOE mission requires. ASCR delivers the power of advanced scientific computation and networking to the wide array of scientific disciplines supported by SC.

In FY 2004, ASCR will embark on research to identify, address and correct bottlenecks that presently constrain DOE's capabilities in modeling and simulation. A research portfolio in Next Generation Computer Architecture will be initiated to assess novel computer architectures and their prospects for achieving optimal performance on DOE's scientific simulations.

In FY 2004, the ASCR program will continue to develop the underlying mathematical algorithms, software building blocks and infrastructure for the "Scientific Discovery through Advanced Computing," (SciDAC) program. SciDAC is an Office of Science research endeavor to produce the scientific computing, networking and software that DOE researchers will need for sustained progress at the scientific forefront in areas of strategic importance to the Department. The scope of the SciDAC program will be extended to include new activities to address the urgent need for a quantitative understanding of matter at the nanoscale.

The ASCR program will also maintain the vitality of its basic research efforts in applied mathematics, computer and computational science, and network research to bolster the foundation for continued success in advancing scientific frontiers through computation.

In FY 2004, the Genomes to Life research activities in partnership with the Biological and Environmental Research program will be expanded to include new research in the applied mathematical sciences that will develop new computational techniques for the study of regulatory networks and metabolic pathways for microbial systems.

Finally, in FY 2004, ASCR will provide high performance computing and networking resources at the levels needed to meet SC needs. The National Energy Research Scientific Computing Center, as a result of an enhancement in FY 2003, will be operated at 10Tflops to meet the computational needs of nearly 2,400 users. The Energy Sciences Network (ESnet) will be operated to provide state of the art network services and capabilities to DOE-supported researchers to collect, analyze, visualize and distribute large-scale scientific data sets.

The **Basic Energy Sciences (BES)** program is a principal sponsor of fundamental research for the Nation in the areas of materials sciences and engineering, chemistry, geosciences, and bioscience as it relates to energy. This research underpins DOE missions in energy, environment, and national security; advances energy related basic science on a broad front; and provides unique user facilities for the U.S. scientific community.

In FY 2004, construction will proceed on three Nanoscale Science Research Centers (NSRCs), project engineering design will be initiated on the fourth NSRC, and a Major Item of Equipment will be initiated for the fifth and final NSRC. NSRCs are user facilities for the synthesis, processing, fabrication, and analysis of materials at the nanoscale. The five NSRCs will be located strategically at national laboratories across the country in New York, Tennessee, Illinois, New Mexico, and California. These facilities, in conjunction with existing user facilities at these national laboratories, will provide a strikingly unique suite of forefront capabilities where the Nation's leading scientists can design and build complex nanoscale materials all in one place.

The five NSRCs will be the Nation's critical focal points for the development of the nanotechnologies that will revolutionize science and technology. They will provide state-of-the-art nanofabrication equipment and quality in-house user support for hundreds of visiting researchers. The Centers will provide an environment for research of a scope, complexity, and disciplinary breadth not possible under traditional individual investigator or small group efforts. As such, the DOE Centers will be the training grounds of choice for the top graduate students and elite postdoctoral associates who will lead the future of scientific research.

A high priority in FY 2004 is continued construction of the Spallation Neutron Source (SNS) to provide the next-generation, short-pulse spallation neutron source for neutron scattering. The project, which is to be completed in June 2006, is on schedule and within budget with over half of the work completed as of the end of FY 2002. At the end of FY 2004, construction of the SNS will be 80% complete.

Today, we have unprecedented opportunities to use advances in biology, computation, engineering, physics, and chemistry, to develop new solutions for challenges in energy, the environment, and health. The **Biological and Environmental Research (BER)** program is bringing these diverse fields together at DOE laboratories, universities, and private research institutes to find innovative approaches along unconventional paths to address DOE challenges.

In FY 2004, the Genomes to Life program continues to develop novel research and computational tools that, when combined with our genomics, structural biology, and imaging research provide a basis to understand and predict responses of complex biological systems. Other BER efforts in the Life Sciences include Human Genome research and DNA sequencing and Low Dose Radiation research.

BER contributions to the President's Climate Change Science program include research in climate modeling, atmospheric composition, and regional impacts of climate change. Carbon cycle research will work toward understanding what fraction of carbon dioxide emissions are taken up by terrestrial ecosystems. New in FY 2004, are ecological research efforts to begin to bridge the knowledge gap between molecular level effects and the responses of entire ecosystems to natural and human-induced environmental changes.

A key challenge in Environmental Remediation Science is to understand the subsurface environment and to then develop innovative options for clean up and protection. In FY 2004, BER research will continue to develop new cleanup strategies, including bioremediation of metals and radionuclides and the treatment and disposal of high-level radioactive wastes stored in large underground tanks. The Environmental Molecular Sciences Laboratory is maintained at the leading edge of computational capabilities for enhanced modeling of environmental and molecular processes.

Because of DOE's diverse capabilities across a range of scientific disciplines, BER Medical Sciences research will continue to provide the medical community with novel devices and technologies to detect, diagnose, and treat disease. One example is research that will develop the capability to detect genes as they are turned on and off in any organ in the body with enormous impacts in developmental biology and the diagnosis of disease.

The **Fusion Energy Sciences** (FES) program leads the national research effort to advance plasma science, fusion science, and fusion technology—the knowledge base needed for an economically and environmentally attractive fusion energy source. The National Energy Policy states that fusion power has the long-range potential to serve as an abundant and clean source of energy and recommends that the Department develop fusion. The next frontier in the quest for fusion power is sustained, burning (or self-heated) plasma. The Fusion Energy Sciences Advisory Committee (FESAC) has concluded that the fusion program is ready to proceed and has recommended joining the ongoing negotiations to construct the international burning plasma experiment, ITER. The National Research Council (NRC) of the National Academy of Sciences has endorsed this strategy. Based on these recommendations and an SC reviewed cost estimate for the construction of ITER, the President has decided to join the ITER negotiations.

Four areas characterize the FES program activities for FY 2004 and beyond. These are *Burning Plasmas*, which will include our efforts in support of ITER; *Fundamental Understanding*, which includes theory, modeling, and general plasma science; *Configuration Optimization*, which includes experiments on advanced tokamaks, advanced magnetic configurations, and inertial fusion concepts, as well as facility operations and enabling R&D; and *Materials and Technology*, which includes fusion specific materials research and fusion nuclear technology research. Integrated progress in all of these thrust areas is required for ultimate success in achieving a practical fusion energy source.

In light of the President's decision to join the ITER negotiations, many elements of the fusion program that are broadly applicable to burning plasmas will now be directed more specifically toward the needs of ITER which will be the focal point of burning plasma fusion research around the world. The U.S.

funding commitment to ITER will increase significantly in the out years as the project moves to construction and eventually to science operations. These increases are consistent with the recommendations of the December 20, 2002, NRC interim report on Burning Plasma.

The FY 2004 budget supports the program balance and priorities recommended by FESAC and supported by the Secretary of Energy Advisory Board and the NRC. The FY 2004 budget request supports continuing the final design and initial fabrication of the National Compact Stellarator Experiment facility at Princeton Plasma Physics Laboratory.

The President's decision to join the ITER negotiations to build a burning plasma experimental facility will require that the longer range technology activities be curtailed to allow a focus on program elements that most directly support preparations for ITER construction, in particular, the operation of existing facilities. The majority of existing and proposed program elements already contribute to tokamak science, thereby providing a strong base for our future contributions to and ability to benefit from ITER.

Whether or not a burning plasma experiment will be realized through the construction and operation of the proposed ITER device will depend on the success of the international negotiations in determining an agreed-upon site for the facility, an agreed-upon financial and procurement arrangement, and satisfactory management and oversight arrangements. In these negotiations, the U.S. will strive for incorporation of its principles of equity, accountability and transparency, which will be an important part of any decision-making process for joining any future construction project. Should the ITER project not proceed to fruition or if the U.S. cannot accept the eventual terms, FESAC has recommended that the U.S. fusion program continue toward a burning plasma experiment, using the FIRE concept (a fusion research experiment to explore the science of short duration burning plasmas) by seeking partnership from within the international fusion community. Specific burning plasma tasks outlined in this budget proposal are supportive of ITER and would also be supportive of FIRE, as the technical physics issues are similar.

The **High Energy Physics** (HEP) program provides over 90% of the Federal support for the Nation's high energy physics research. This research seeks to understand the nature of matter and energy at the most fundamental level, as well as the basic forces that govern all processes in nature. High energy physics research requires accelerators and detectors utilizing state-of-the-art technologies in many areas including fast electronics, high speed computing, superconducting magnets, and high power radio-frequency devices. Until 2007, when Europe's Large Hadron Collider (LHC) is scheduled to begin operations, the U.S. is the primary world center for HEP research. In FY 2004, the HEP program will concentrate on facility utilization, including direct support for researchers, as well as incremental facility upgrades.

In FY 2004, the Fermilab Tevatron Collider Run II will be in full swing, with an ultimate goal of discovering the long-sought Higgs particle, thought to be the key to understanding why particles have mass. But en route to that goal, the Run II program will in the near term enable many advances and discoveries at the energy frontier, including providing much more information about the heaviest known particle, the top quark, discovered at Fermilab in 1995; discovery or elimination of an entirely new class of particles, predicted by many theories to be present in Run II data; or even unfolding of the undiscovered space-time dimensions that have been postulated to complete the unification of fundamental interactions. A series of planned upgrades to the Tevatron accelerator complex, the major detectors, and computing facilities will continue in FY 2004 in order to enable a vigorous physics program that will maintain Fermilab's scientific leadership through the end of the decade. In addition, the Neutrinos at the Main Injector (NuMI/MINOS) project, scheduled for completion in September

2005, will provide a world-class facility to study neutrino properties and make definitive measurements of neutrino mass differences.

Building on the outstanding performance of the B-factory at the Stanford Linear Accelerator Center (SLAC), the HEP program will increase support for operation of the B-factory in FY 2004 to break new ground in exploring the source and nature of matter-antimatter asymmetry in the B-meson system. The upcoming round of experimental results may provide evidence for new physics beyond the Standard Model of particle physics. Incremental upgrades are also planned in FY 2004 for the accelerator to improve physics output and for the computing capabilities to cope with high data volumes.

Continued U.S. participation in the LHC project at CERN is a high priority in FY 2004. The U.S. contributions to the LHC accelerator and the ATLAS and CMS detectors are on schedule and within budget for the scheduled start-up date of 2007. Focus of this effort will begin to shift in FY 2004 from construction to pre-operations for the U.S.-built detector components and to developing the software and computing infrastructure necessary to exploit LHC physics.

Progress continues on particle astrophysics experiments and R&D in partnership with NASA. Collaborations on the Alpha Magnetic Spectrometer (AMS) and the Large Area Telescope (LAT), part of the Gamma-Ray Large Area Space Telescope (GLAST) mission, will be engaged in full detector fabrication and assembly in FY 2004. The SuperNova Acceleration Probe (SNAP) will begin fabrication of detector prototypes in support of a 2006 Conceptual Design. These experiments are working toward understanding diverse phenomena in astrophysics and cosmology, including dark energy, high energy gamma ray sources, and antimatter in space, all of which play a role in the story of the origin and fate of the Universe.

In addition, the program continues to support advanced technology R&D in FY 2004 geared toward future accelerators, including a high-energy, high-luminosity Linear Collider to complement and extend the physics program of the LHC. In January 2002, the HEPAP Subpanel on Long Range Planning stated that such a collider should be the highest priority of the U.S. HEP program.

The **Nuclear Physics** (NP) program supports fundamental nuclear physics research, providing about 90% of Federal support for this field. NP research advances our knowledge of the properties and interactions of atomic nuclei and nuclear matter in terms of the fundamental forces and particles of nature. It also supports the scientific knowledge-base, technologies and trained manpower that are needed to underpin DOE's missions for nuclear-related national security, energy, and the environment.

The NP program seeks answers to questions in three broad areas. (1) The basic constituents of nuclei, the neutrons and protons (nucleons) are themselves each composed of three quarks and the gluons that "carry" the strong force between them. Yet, these quarks are "confined" and cannot be found individually in nature. Understanding this confinement and the transition from a nucleon to quark description of nuclear structure is a central question of the field. (2) The early universe, up to a millionth of a second after the "Big Bang", is believed to have been a soup of quarks and gluons, a quark-gluon plasma. Creation of microcosms of this primordial matter in the laboratory is now being attempted in order to answer how the universe evolved at the very beginning of time. (3) The chemical elements are believed to have been created in stars and supernovae explosions, yet the nuclear reactions involved in this process involve nuclei far from the naturally occurring ones on earth. To answer how the elements were made (nucleosynthesis) requires producing exotic radioactive nuclear beams. Understanding the dynamics of supernovae also requires understanding the properties of the elusive neutrino which can only be detected in massive detectors.

In FY 2004, the NP program will focus on enhancing the operations of the program's user facilities, especially the Relativistic Heavy Ion Collider (RHIC), so as to bring all operating facilities to about 83 percent of optimal utilization. This will increase beam hours for research by about 5 percent over the FY 2003 Request. Operation of the 88-Inch Cyclotron at Lawrence Berkeley National Laboratory is terminated in FY 2004. Nuclear Theory, new Low Energy instruments, and increased support to non-accelerator research such as neutrino experiments are also strongly supported.

In addition to increased operations at RHIC, FY 2004 funding will support an aggressive experimental program with the newly completed G0 detector at Thomas Jefferson National Accelerator Facility (TJNAF) to begin to map out the strange quark contribution to the structure of the nucleon. The MIT/Bates research program with the BLAST detector is being initiated in FY 2003 with completion planned in FY 2004. The two Low Energy user facilities (ATLAS and HRIBF) will also increase running schedules in FY 2004 for nuclear structure and astrophysics studies.

In FY 2003-2005, the Sudbury Neutrino Observatory (SNO) will make sensitive measurements of the flux and spectra of solar neutrinos. Neutrino oscillations are evidence that neutrinos have mass, an observation that forces a re-evaluation of the existing Standard Model of particle physics.

The **Science Laboratories Infrastructure (SLI)** program plays a vital role in enabling the continued performance of world-class research at SC laboratories by funding line item construction projects to maintain the general purpose infrastructure (GPI) and the clean up and removal of excess facilities. In FY 2004 SLI will support six ongoing projects and one new start - seismic safety and operational reliability improvements at the Stanford Linear Accelerator Center (SLAC). Excess Facilities Disposition (EFD) subprogram funds will accelerate disposition of both contaminated and non-contaminated excess SC facilities, resulting in reduction of costs and risks while freeing-up valuable land. The FY 2004 Budget Request also includes funding for the Oak Ridge Landlord subprogram.

Safeguards and Security reflects SC's commitment to maintain adequate protection of cutting edge scientific resources. In FY 2004, Safeguards and Security will enable SC labs to meet the requirements of maintaining approved Security Condition 3 level mandates for the protection of SC assets. Integration of security into the laboratories' systems and continued risk management are also supported. In addition, critical cyber security tools and software will be purchased to respond to the ever changing cyber threat.

Workforce Development for Teachers and Scientists supports three subprograms: Pre-College Activities such as the National Science Bowl; the Undergraduate Research Internships for undergraduate students wishing to enter science, technology and science teaching careers; and Graduate/Faculty Fellowships for K-16 teachers of science, technology, engineering, and mathematics (STEM). Each of the sub-programs targets a different group of students and teachers in order to attract a broad range of participants to the programs and expand the nation's supply of well-trained scientists and engineers. Focus of this program is on the Physical Sciences and other areas of research which underpin the DOE missions and have, over the last decade, seen a marked decline in the numbers of undergraduate degrees awarded. Initiated in FY 2004 is the Laboratory Science Teacher Professional Development program that will provide long-term scientific community support from our National Laboratories for K-14 STEM teachers.

Science Program Direction enables a skilled, highly motivated Federal workforce to manage SC's research portfolio, programs, projects, and facilities in support of new and improved energy, environmental, and health technologies, and to provide continuous learning opportunities. Science Program Direction consists of four subprograms: Program Direction, Field Operations, Technical Information Management (TIM) and Energy Research Analyses (ERA).

The Program Direction subprogram supports Federal staff in Headquarters responsible for directing, administering, and supporting the broad spectrum of scientific disciplines. The Field Operations subprogram is the funding source for the Federal workforce in the Field complex responsible for providing business, administrative, and specialized technical support to DOE programs. The TIM subprogram collects, preserves, and disseminates the scientific and technical information of the DOE. The ERA subprogram provides the capabilities needed to evaluate and communicate the scientific excellence, relevance, and performance of SC basic research programs.

As part of the Restructuring effort, SC will focus on its Federal human capital in FY 2004 to effectively respond to the science needs of the future and to the challenge of an anticipated 50 percent turnover of retirement-eligible senior scientists over the next five years. Also in FY 2004, SC continues to support a corporate DOE information management system, the Electronic R&D Portfolio Management Tracking and Reporting Environment (ePME), which enables end-to-end tracking of research projects, information sharing across programs, and snapshots of the Department's R&D portfolio. ePME will integrate with the e-Grants functions of e-Government, the Department's e-Financial Management System, and the e-Procurement Modernization System.

A Vision for the Future

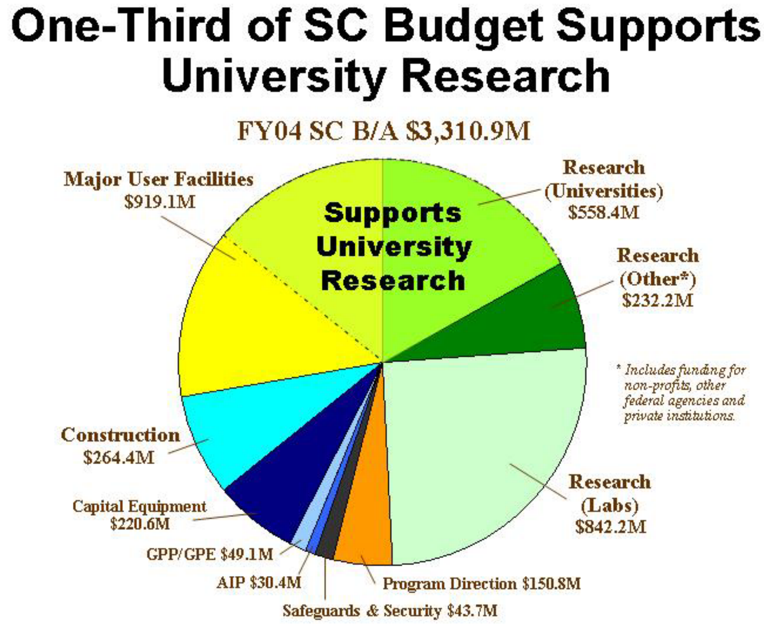
SC sponsors research that often involves long time scales and requires a clear strategy. Raymond Davis, for example, conducted his seminal research over a 30-year time period and was highly focused on a goal that many others thought was beyond the technology of the time. His work built on the prediction by Wolfgang Pauli, in 1930, that neutrinos exist and has led to other path breaking research including the announcement in 2001, by a team including SC supported researchers, that neutrinos oscillate among three distinct types during their journey from the Sun to the Earth, thus helping to explain the perceived absence of solar neutrinos. This discovery also challenged long-held views regarding whether neutrinos have mass.

The Department's emerging strategic direction for SC focuses on three long-range goals. These goals are being brought to life through the investments made in this FY 2004 budget request:

- *DOE-sponsored research leads the world in scientific advances in energy-related basic sciences.*
- *DOE is the recognized leader in the integration of the physical sciences, biology, and engineering, providing innovative interdisciplinary approaches and technologies that improve human health.*
- *DOE is the major provider of the Nation's research facilities for the physical sciences and computation, and contributes unique, vital facilities to the biological and environmental sciences.*

SC's vision for the next five years will be articulated in a new Strategic Plan, which will be issued in early 2003. The Plan will detail future scientific directions within the Office of Science for DOE missions and for our Nation. Key to development of that Strategic Plan is consistency with the Department's missions and objectives, a deep understanding of the scientific challenges that will face our Nation during the 21st Century, and maximization of the limited resources available to the Department.

How We Manage our Programs



SC manages a significant portion of the Nation's R&D enterprise and is the single largest supporter of basic research in the physical sciences in the United States, providing more than 40 percent of total funding for physics, chemistry, materials science and other areas of the physical sciences. SC also manages research at 10 national laboratories and the world's most diverse portfolio of unique and powerful scientific tools – including particle accelerator centers, neutron sources, high-powered light sources, advanced computational centers, and atmospheric monitoring facilities. In addition, SC funds more than 7,000 individual research projects at universities, national laboratories, U.S. industry and the non-profit sector. Fully one-third of the SC budget supports university research.

All told, more than 25,000 highly skilled scientists, technicians and engineers depend upon SC's stewardship of vital scientific resources – either through direct support or through access to scientific user facilities. Managing this complex research portfolio requires hard choices about areas of science to fund, constant communication with the scientific community, and an ability to meet the challenges that affect SC's management of these resources.

SC relies upon the expert opinions of the U.S. scientific community to set priorities, particularly through the use of six independent advisory committees, extensive competition through grants and contracts for the best qualified scientific talent and ideas, and through the peer review of virtually all of the scientific proposals that are eventually funded.

Embracing the President's Management Agenda

The President's Management Agenda (PMA) articulates a performance management framework that the Office of Science is adopting at all levels of its management structure. The PMA is leading to major restructuring in four areas:

> *"What matters in the end is completion. Performance. Results. Not just making promises, but making good on promises. In my Administration, that will be the standard, from the farthest Regional Office of government to the highest office of the land."*
>
> President George W. Bush

Management of Human Capital: In FY 2002, SC initiated a Workforce Restructuring Project to define the principles by which SC and its Field sites will operate and to clarify roles, responsibilities, authorities and accountabilities across the entire organization. This effort will improve the management and implementation of programs by reducing layers of management, streamlining decision-making processes, clarifying lines of authority, and utilizing resources more efficiently throughout SC and its Field sites. The changes planned are consistent with both the President's Management Agenda and SC's Business Vision. The Restructuring Project will determine staffing needs throughout the SC complex.

Competitive Sourcing: Through a series of competitive sourcing studies, the DOE will review 927 federal positions in FY 2002-FY 2003 to evaluate whether the necessary services provided should be provided by federal employees or by the private sector. More than 170 positions are being studied at SC sites.

Expanded E-Government: By the end of FY 2004, 100% of grant and contract proposals will be received electronically by SC, 65% of purchase orders will be done electronically, and 80% of field budget information will be processed electronically - including 100% of new projects.

Budget & Performance Integration: For the second year, SC has included in the Budget Request, detailed performance information (including annual targets) aligned with major program goals.

Program Assessment Rating Tool (PART)

In implementing the PMA, the Office of Management and Budget (OMB) developed the PART to assess the *purpose, planning, management,* and *performance* of Federal programs. The six SC research programs each completed a PART analysis for the FY 2004 budget request. All of the SC programs received perfect scores in the *purpose* section and generally very high scores in the *management* section. These high scores are due to standard management practices across SC that result in programs with well defined missions, merit-based reviews for awarding contracts and grants, and highly-regarded large-scale project management practices. However, all of the SC programs were assessed "results not demonstrated". The primary cause for this, and for the generally lower scores in the *planning* and *results* sections, is that OMB and SC have not yet reached agreement on the appropriate long-term and annual performance measures for SC basic research programs. OMB has acknowledged that establishing practical and meaningful performance measures for basic research is inherently difficult because of the largely unpredictable nature of scientific inquiry and the great deal of variation across scientific disciplines. SC has worked with OMB, invested in research into science performance measurement, and hosted interagency working group meetings to improve performance metrics. SC expects to resolve the issue in FY 2004 through the development, validation, and implementation of a suite of long-term and annual performance measures for federal research.

> *"…some of the most interesting problems are decade-long problems or multi-decade-long problems and they can be really worth that investment…"*
>
> *"…having a sustained source of consistent funding is really extremely important in all areas of science…"*
>
> *"By taking some risks, trying to do things that aren't necessarily quite so clear but that have potentially huge payoffs, rewards can be very great."*
>
> **2002 Lawrence Award Winners Perlmutter, Brinker and Hodgson**

Dr. Raymond L. Orbach
Director
Office of Science

Table 1

OFFICE OF SCIENCE

FY 2004 PRESIDENT'S BUDGET REQUEST TO CONGRESS
(B/A in thousands of dollars)

	FY 2002 Comparable Appropriation	FY 2003 Comparable President's Request	FY 2004 President's Request
Science			
Basic Energy Sciences	979,560	1,019,163	1,008,575
Advanced Scientific and Computing Research	150,205	166,557	173,490
Biological and Environmental Research	554,125	484,215	499,535
Fusion Energy Sciences	241,100	257,310	257,310
High Energy Physics	697,383	724,990	737,978
Nuclear Physics	350,589	382,370	389,430
Science Laboratories Infrastructure	37,125	42,735	43,590
Science Program Direction	149,467	137,332	150,813
Workforce Development for Scientists and Teachers	4,460	5,460	6,470
Small Business Innovation Research and Small		-	-
Business Technology Transfer	99,668	-	-
Subtotal	3,263,682	3,220,132	3,267,191
Safeguards and Security			
Safeguards and Security	50,230	48,127	48,127
Reimbursable Work	(4,460)	(4,383)	(4,383)
Total, Safeguards and Security	45,770	43,744	43,744
Total Science	3,309,452	3,263,876	3,310,935

Table 2

OFFICE OF SCIENCE
FY 2004 PRESIDENT'S BUDGET REQUEST TO CONGRESS
(B/A in thousands of dollars)

	FY 2002 Comparable Appropriation	FY 2003 Comparable President's Request	FY 2004 President's Request
Genomes to Life	21,696	42,414	66,906
U.S. Global Climate Change Research Program	117,329	126,169	108,104
Climate Change Research Initiative	-	2,920	25,335
High Performance Computing and Communications	168,148	182,636	190,068
Nanoscience Engineering and Technology	88,726	133,040	196,541
Workforce Development for Teachers and Scientists	4,460	5,460	6,470

Table 3

Institutional General Plant Projects

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$ Change	% Change
Oak Ridge National Laboratory	1,225	6,000	6,000	+0	+0.0%
Pacific Northwest National Laboratory	0	1,000	3,000	+2,000	+200.0%
Total, Institutional General Plant Projects	1,225	7,000	9,000	+2,000	$28.6%

Table 4

OFFICE OF SCIENCE
FY 2003 PRESIDENT'S BUDGET REQUEST TO CONGRESS
(B/A in thousands of dollars)

Major Site Funding	FY 2002 Comparable Appropriation	FY 2003 Comparable President's Request	FY 2004 President's Request
AMES LABORATORY			
Advanced Scientific and Computing Research	2,183	1,625	1,578
Basic Energy Sciences	18,377	16,507	16,502
Biological and Environmental Research	830	512	555
Safeguards and Security	397	409	409
Total Laboratory	21,787	19,053	19,044
ARGONNE NATIONAL LABORATORY			
Advanced Scientific and Computing Research	13,503	8,573	11,646
Basic Energy Sciences	156,916	152,734	166,066
Biological and Environmental Research	24,446	22,970	23,295
Fusion Energy Sciences	1,662	1,522	1,192
High Energy Physics	9,849	10,293	10,043
Nuclear Physics	18,453	17,548	18,709
Safeguards and Security	7,679	7,809	7,809
Science Laboratories Infrastructure	3,643	4,205	6,002
Workforce Development for Teachers & Scientists	430	615	570
Total Laboratory	236,581	226,269	245,332
BROOKHAVEN NATIONAL LABORATORY			
Advanced Scientific and Computing Research	1,359	542	960
Basic Energy Sciences	59,158	57,398	61,755
Biological and Environmental Research	23,749	16,248	14,964
High Energy Physics	39,117	23,319	21,161
Nuclear Physics	140,108	149,004	149,588
Safeguards and Security	10,916	10,970	10,970
Science Laboratories Infrastructure	7,413	8,513	5,917
Workforce Development for Teachers & Scientists	430	615	522
Total Laboratory	282,250	266,609	265,837

	FY 2002 Comparable Appropriation	FY 2003 Comparable President's Request	FY 2004 President's Request
FERMI NATIONAL ACCELERATOR LABORATORY			
Advanced Scientific and Computing Research			
Energy Research Analyses	326	60	226
High Energy Physics	306,782	313,200	304,663
Nuclear Physics	231	-	-
Safeguards and Security	2,684	2,837	2,837
Science Laboratories Infrastructure	53	-	233
Workforce Development for Teachers & Scientists	20	100	50
Total Laboratory	310,096	316,197	308,009
IDAHO NATIONAL ENGINEERING LABORATORY			
Basic Energy Sciences	1,784	1,494	1,494
Biological and Environmental Research	2,428	2,205	3,400
Fusion Energy Sciences	2,356	2,392	1,823
Workforce Development for Teachers & Scientists	10	-	100
Total Laboratory	6,578	6,091	6,817
LAWRENCE BERKELEY NATIONAL LABORATORY			
Advanced Scientific and Computing Research	65,872	53,223	57,686
Basic Energy Sciences	81,885	78,691	108,247
Biological and Environmental Research	72,102	42,786	53,055
Fusion Energy Sciences	5,952	5,799	5,718
High Energy Physics	43,284	32,530	39,183
Nuclear Physics	19,943	18,615	15,840
Safeguards and Security	4,706	4,753	4,753
Science Laboratories Infrastructure	6,900	5,607	2,975
Science Program Direction	-	50	100
Workforce Development for Teachers & Scientists	505	750	600
Total Laboratory	301,149	242,804	288,157

	FY 2002 Comparable Appropriation	FY 2003 Comparable President's Request	FY 2004 President's Request
LAWRENCE LIVERMORE NATIONAL LABORATORY			
Advanced Scientific and Computing Research	4,119	-	3,068
Basic Energy Sciences	5,481	4,676	4,676
Biological and Environmental Research	27,539	28,199	36,502
Fusion Energy Sciences	14,510	14,411	13,408
High Energy Physics	1,221	429	429
Nuclear Physics	664	507	700
Science Laboratories Infrastructure	350	250	250
Total Laboratory	53,884	48,472	59,033
LOS ALAMOS NATIONAL LABORATORY			
Advanced Scientific and Computing Research	3,709	5,020	3,570
Basic Energy Sciences	25,089	23,041	23,634
Biological and Environmental Research	23,545	19,245	19,717
Fusion Energy Sciences	7,799	7,308	3,765
High Energy Physics	984	825	825
Nuclear Physics	9,652	9,123	9,104
Science Program Direction	653	670	1,450
Total Laboratory	71,431	65,232	62,065
NATIONAL RENEWABLE ENERGY LABORATORY			
Basic Energy Sciences	5,412	4,562	4,562
Workforce Development for Teachers & Scientists	-	150	200
Total Laboratory	5,412	4,712	4,762
OAK RIDGE NATIONAL LABORATORY			
Advanced Scientific and Computing Research	26,629	10,496	9,819
Basic Energy Sciences	398,845	343,176	257,609
Biological and Environmental Research	58,549	37,495	38,448
Fusion Energy Sciences	19,454	19,258	18,693
High Energy Physics	673	660	660
Nuclear Physics	15,974	16,870	19,330
Safeguards and Security	9,509	7,913	7,913
Science Laboratories Infrastructure	10,745	12,016	10,600
Science Program Direction	60	-	50
Total Laboratory	540,438	447,884	363,122

	FY 2002 Comparable Appropriation	FY 2003 Comparable President's Request	FY 2004 President's Request
OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION			
Advanced Scientific and Computing Research	306	99	200
Basic Energy Sciences	2,203	872	872
Biological and Environmental Research	5,850	4,761	4,550
Fusion Energy Sciences	347	808	888
High Energy Physics	80	130	130
Nuclear Physics	607	189	194
Safeguards and Security	1,081	1,254	1,254
Science Program Direction	24	55	100
Workforce Development for Teachers & Scientists	1,377	1,250	1,292
Total Laboratory	11,875	9,418	9,480
PACIFIC NORTHWEST NATIONAL LABORATORY			
Advanced Scientific and Computing Research	4,097	1,003	3,601
Basic Energy Sciences	13,128	11,648	11,648
Biological and Environmental Research	86,047	77,677	81,105
Fusion Energy Sciences	1,415	1,556	1,440
High Energy Physics	54	-	-
Nuclear Physics	20	-	-
Science Laboratories Infrastructure	1,377	4,000	4,120
Science Program Direction	414	465	700
Workforce Development for Teachers & Scientists	635	740	690
Total Laboratory	107,187	97,089	103,304
PRINCETON PLASMA PHYSICS LABORATORY			
Advanced Scientific and Computing Research	400	-	420
Fusion Energy Sciences	69,607	63,576	70,563
High Energy Physics	268	364	364
Safeguards and Security	1,828	1,855	1,855
Science Laboratories Infrastructure	875	545	980
Science Program Direction	-	-	-
Workforce Development for Teachers & Scientists	125	100	150
Total Laboratory	73,103	66,440	74,332

	FY 2002 Comparable Appropriation	FY 2003 Comparable President's Request	FY 2004 President's Request
SANDIA NATIONAL LABORATORY			
Advanced Scientific and Computing Research	5,783	3,889	6,047
Basic Energy Sciences	25,977	25,987	52,949
Biological and Environmental Research	5,334	3,757	5,846
Fusion Energy Sciences	3,178	3,213	2,786
Science Program Direction	155	100	500
Total Laboratory	40,427	36,946	68,128
SAVANNAH RIVER LABORATORY			
Biological and Environmental Research	754	485	239
Fusion Energy Sciences	50	49	45
Total Laboratory	804	534	284
STANFORD LINEAR ACCELERATOR CENTER			
Advanced Scientific and Computing Research	702	234	613
Basic Energy Sciences	34,073	41,716	38,943
Biological and Environmental Research	4,435	5,550	3,675
High Energy Physics	161,587	163,887	169,845
Safeguards and Security	2,150	2,207	2,207
Science Laboratories Infrastructure	400	-	2,000
Workforce Development for Teachers & Scientists	150	150	150
Total Laboratory	203,497	213,744	217,433
THOMAS JEFFERSON NATIONAL ACCELERATOR FACILITY			
Advanced Scientific and Computing Research	100	-	-
Biological and Environmental Research	632	500	-
Nuclear Physics	74,761	79,138	82,247
Safeguards and Security	927	972	972
Science Laboratories Infrastructure	-	1,500	3,914
Workforce Development for Teachers & Scientists	50	100	100
Total Laboratory	76,470	82,210	87,233